KEY ELEMENTS

OF A STRATEGIC PLAN

TO IMPLEMENT THE DELTA VISION

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Submitted to:

Delta Vision Blue Ribbon Task Force

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TO IMPLEMENT THE DELTA VISION

Executive Summary

- Nine clear, measurable and enforceable targets for the Delta ecosystem, to maintain resident fish populations at levels greater than the 1967 – 1991 period before the ecosystem collapse; restore 325,000 acres of four habitat types in the Delta, Suisun Marsh and adjacent areas; increase Delta outflow to about 65% of spring runoff, and to higher levels in the fall as well; and provide other environmental benefits.
- Enough dedicated environmental water to meet the targets.
- A new Delta Water Master to oversee use of the environmental water.
- A new Delta State Park and National Heritage Area, along with stronger oversight of land use in all areas of the Delta.
- A new water use fee, and specific criteria for financing future projects.

INTRODUCTION

At the heart of the conflict over the fate of the Sacramento-San Joaquin Delta has been an approach to managing the Delta's resources that is intended to maximize water diversion and land conversion while limiting the protection of native species and habitats to regulatory minima and voluntary efforts. By designating the Delta ecosystem as a co-equal value that must function as an integral part of a healthy estuary, and by calling for the incorporation of the constitutional principles of reasonable use and public trust into water resource policymaking and for other improvements in institutions and policies, the Delta Vision seeks to redress the imbalance between protection of the Delta ecosystem and how the Delta is managed for water supply and land use. The Strategic Plan must first and foremost identify the steps necessary to elevate Delta ecosystem protection as a co-equal value.

The Delta Vision Blue Ribbon Task Force has invited interested parties to propose elements for its October 2008 Strategic Plan with emphasis on three areas (appropriately incorporating the principles of reasonable use and public trust in California water policy making; governance and strategic finance; and reliable water for California). Recommendations concerning the third area will be the subject of a separate document. In order to adequately address the first two areas, establish the co-equal values of the Delta ecosystem, and implement the twelve recommendations contained in the November 30, 2007, Delta Vision, the Bay Institute, the Environmental Defense Fund, the Natural Resources Defense Council, Defenders of Wildlife and Sierra Club California propose the following Strategic Plan elements:

1. Adopting clear, measurable and enforceable targets for protection of the Delta ecosystem as an integral part of a healthy estuary that address abundance of estuarine species, extent of tidally and seasonally inundated habitat, frequency and duration of Delta outflows, and limit entrainment and contaminant effects to levels that do not harm Delta species.
2. Incorporating ecosystem targets that comply with the public trust constitutional requirement, by statute, rulemaking and executive order as appropriate, in the state and local permits and licenses of all water users and land managers.
3. Securing additional water for the environment to help meet ecosystem targets, including a new state environmental water right allowing for the appropriation of water to augment minimum regulatory requirements for fish and wildlife purposes.
4. Creating a new Delta Water Master entity to manage environmental water, beyond the minimum regulatory requirements, and to oversee water operations in the Delta and interbasin transfers.
5. Strengthening regulation of land use in the Delta by creating the Delta equivalent of the Bay Conservation and Development Commission (through modification of the Delta Protection Commission or replacement with a new entity).
6. Working with Delta communities to establish a new Delta State Park and Delta National Heritage Area,

7. Implementing clearly defined “beneficiary pays” criteria within all aspects of the Delta Vision, with particular attention to costly infrastructure projects.
8. Establishing user fees based on the volumetric consumption of water, and other funding sources to support attainment of Delta ecosystem targets and other public policy purposes.

INCORPORATING THE PUBLIC TRUST PRINCIPLE IN WATER POLICYMAKING: ECOSYSTEM TARGETS; PERMITS AND LICENSES; NEW ENVIRONMENTAL WATER

The following section provides details on the first three steps, which are intended to incorporate the public trust constitutional requirement into decisions about resource policy and management: ecosystem targets, their incorporation into state and local permits and licenses, and a new environmental water right.

Last fall, a number of highly respected scholars correctly pointed out to the Task Force that the reasonable use and public trust doctrines are synergistic and reinforcing: "A use of water violative of elements of the public trust is not reasonable." As these scholars stated, the constitutional requirement of "reasonable use" and the even more ancient doctrine of the public trust are twin foundations of California water law. The right to use water is limited to the amount of water reasonably required for the beneficial use to be served. The right does not extend to waste, or to unreasonable methods of diversion. What constitutes reasonable

use must take into account not only the rights of other water users but the broader public interest. Under the California constitution, Art 10, sec 2, no one in this state can have a protectable interest in the unreasonable use of water.

The public trust doctrine provides that the people of California own all of its waterways and lands beneath and that the state government serves as "trustee of a public trust for the benefit of the people." *National Audubon Society v Superior Court* (1983). 658 P.2d 709 (*National Audubon*). The doctrine imposes on the state an ongoing duty to protect "trust resources" which include explicitly fish, aquatic habitats, and even scenic beauty. In practical terms, the public trust means that - as is true under the reasonable use doctrine - no one can obtain a vested right in a use of water that harms trust resources. At best, water rights are burdened with an ongoing examination of the water requirements to ensure the long-term health of trust resources.

National Audubon, decided a quarter century ago, remains the pre-eminent California Supreme Court case on this issue. The court held that the public trust is not simply an affirmation of the power of the state to use water for general public purposes, even the important public purpose of providing drinking water. Rather, the public trust is "an affirmation of the duty of the state to protect the people's common heritage of streams, lakes, marshlands, and tidelands, surrendering that right only in rare cases where abandonment is consistent with the purposes of the trust." Thus, as the professors pointed out, all elements of state government have the duty to protect, preserve and even restore the state's public trust resources, such as fish, habitat and wildlife.

For the purposes of the Delta Vision, the great benefit of *National Audubon* is that it provides a roadmap for integrating long-standing water rights with these concepts of ensuring environmental health. The court declined to hold that all past allocations harmful to trust resources were improper, but strongly confirmed the state's obligation to correct past mistakes regardless of the longevity of water rights. Key to this holding was the court's rejection of the argument that 'vested' water rights preclude the application of public trust or reasonable use principles to an environmental problem. Indeed, the high court reiterated eight separate times within the opinion that no one can acquire vested rights to use water in a manner harmful to trust resources.

So how does the state integrate existing water management and the public trust and reasonable use doctrines? *National Audubon* accomplishes this integration through a weighted balance. The public trust imposes a substantive duty on the State to affirmatively protect fish and other water-related resources "whenever feasible," and must "avoid or minimize any harm" to those resources.

Reasonable use and public trust principles both require that water diversions must be compatible with a healthy environment. Placing an environmental standard as the foundation for water policy is one of the most important ways that Delta Vision's Strategic Plan could incorporate these principles into water management going forward.

In the past, the State has felt constrained even when environmental harm was specifically

the anticipated result of proposed diversions. In 1940, when it issued the water rights permits to Los Angeles that would later be at issue in *National Audubon*, the State Water Resources Control Board (the State Water Board) knew that its actions were going to cause grave harm to Mono Lake. The Board characterized this result as "indeed unfortunate," but stated that "there is apparently nothing that this office can do to prevent" the diversions. *National Audubon*, 658 P.2d at 714, citing Division of Water Resources Decs. 7053 et al. (April 11, 1940).

The way to best incorporate these principles in water policy making and Delta resource management is to adopt specific ecosystem targets and then incorporate them into all relevant permits and licenses.

Targets for protection of the Delta ecosystem as an integral part of a healthy estuary

Viable and Resilient Populations

The Delta Vision's overarching goal that the Delta function as an integral part of a healthy estuary requires that it be able to support viable, resilient populations of estuarine species.

Target 1. Restore abundance of estuarine fish species to greater than 104% of average levels measured during the 1967-1991 period.

This performance target measures the combined abundance of three estuarine fish species (delta smelt, longfin smelt, and splittail) relative to their average combined abundance measured for the 1967-1991 period (Figure 1). These species were selected because they represent estuary-dependent aquatic organisms with a wide range of life-history requirements. The target level, greater than the average 1967-1991 abundance (or greater than the average plus one standard error, or >104%), represents an abundance level at which estuarine fish populations are viable (i.e., at low risk of extinction) and resilient (i.e., capable of responding to variations in environmental conditions without

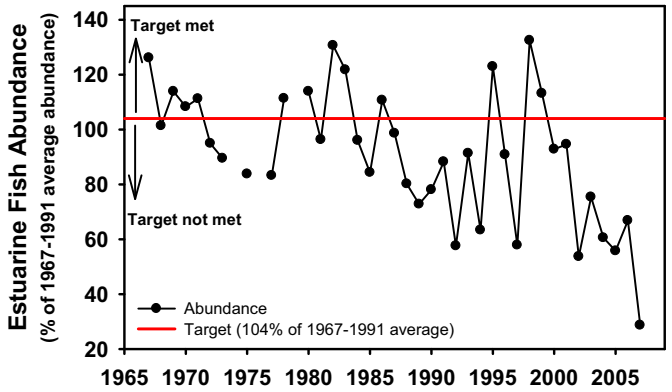

Figure 1. Combined abundance of three native estuarine fish species (delta smelt, longfin smelt, and splittail) relative to their average abundance during the 1967-1991 period. The performance target is an abundance level that is greater than 104% of the 1967-1991 average.

collapsing). This target complements but does not replace existing statutory and regulatory targets for Bay-Delta species, including the federal and state requirements to double natural production of Chinook salmon and other anadromous fish species.

Habitats

Three of the performance targets are designed to restore the extent and diversity of physical habitat types and the complexity of channel configurations by restoring specific acreages of tidal marsh, uplands and seasonal wetlands, and floodplains.

Target 2. Restore 80,000 acres of tidal marsh habitat in the Delta and 50,000 acres of tidal marsh habitat in Suisun Marsh.

This performance target measures the total area of vegetated lands with elevations ranging from mean lower low water to mean higher high water that are fully exposed to tidal action and are connected to the other tidal marshes, the Delta and/or the estuary by waterways. These habitats support estuarine and migratory species, increase primary and secondary productivity in the estuary, export of carbon and food organisms to the Delta and estuary, and improve water quality by filtering contaminants from surface runoff and tidally exchanged waters. More than 90% of historic tidal marsh habitat has been lost in the Delta and Suisun Marsh; therefore the target levels represent the total areas of land with the appropriate elevation in each region. The state already owns significant amounts of land in the Delta that could be restored as tidal marsh.

Target 3. Restore 130,000 acres of terrestrial grasslands and seasonal wetland complexes in the Delta and 5000 acres in Suisun Marsh.

This performance target measures the total area of lands in the Delta and Suisun Marsh with elevations above mean higher high water that support terrestrial grasslands and/or season wetland complexes. These habitats support wildlife, improve water quality by filtering contaminants in surface runoff, and provide accommodation space for sea level rise; therefore the target levels represent the total areas of land with the appropriate elevation in each region.

Target 4. Restore 60,000 acres of floodplain habitat to seasonal inundation for a minimum of 45 consecutive days at least once every two years.

This performance target measures the total area of lands adjacent to Delta tributary rivers with elevations above mean higher high water that are inundated by river flow during the spring (February-May). Seasonally inundated floodplains provide spawning habitat for splittail (one of the target estuarine fish species), an enhanced migration corridor for juvenile salmonids, robust primary and secondary productivity for export to the Delta, and improved flood protection in adjacent and downstream areas. The target season and acreage and duration levels are designed to support these objectives.

<u>Ecological Processes</u>

Ecological processes in the Delta include transport of materials (e.g., by flow and tidal exchange across connections between different habitat types), primary and secondary productivity, seasonal variability in environmental conditions (e.g., flow, location and

area of low salinity habitat, temperature), and disturbance (e.g., flood events). Some of these processes are provided by the natural function of specific habitat types (e.g., tidal marshes or floodplains) but others are tightly linked with water management operations that control freshwater inflows to the estuary. Two of the performance targets are designed to address seasonal freshwater inflows and the resultant estuarine open water habitat quantity and quality.

Target 5. Restore spring Delta outflow to provide low salinity habitat in Suisun Bay, with average February-June X2 values ranging from less than or equal to 70 km from the Golden Gate in critically dry years to less than or equal to 58 km in wet years.

This performance target measures the volume of Delta outflow (or freshwater inflow into San Francisco Bay) and the resultant location of low salinity, open water habitat during the spring (February-June; Figure 2). The ecologically important spring season is when upstream dam and Delta water export operations have had the greatest effects, reducing spring outflows by more than 50% in many years. The water year type dependent target levels are based on statistically significant relationships between spring

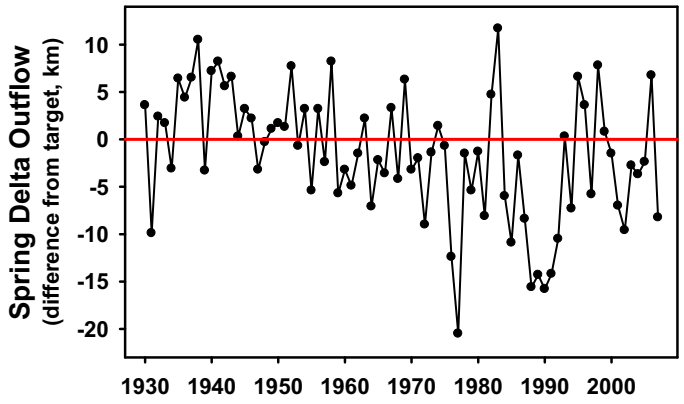

Figure 2. Spring Delta outflow (as X2) compared to the water year type dependent spring outflow target (as X2). The performance target varies with water year type and is therefore shown at 0 as the horizontal red line. The Y axis shows the difference in measured spring X2 from the performance target: positive values indicate that outflow exceeded the target, negative values indicate that outflow was less than the target.

outflow and estuarine fish population abundance and designed to provide conditions that previously supported estuarine fish populations at levels that would meet Target 1 by increasing Delta outflow to about 65% of unimpaired runoff.

Target 6. Restore fall Delta outflow to provide low salinity habitat downstream of the Sacramento-San Joaquin River confluence, with September-November average X2 values less than 80 km in all years except critically dry years.

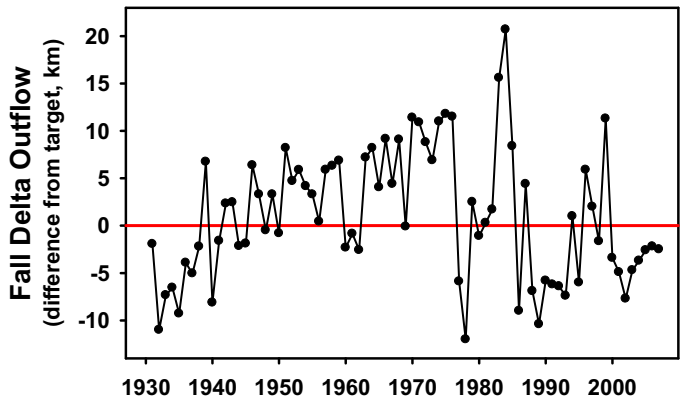

Figure 3. Fall Delta outflow (as X2) compared to the water year type dependent outflow target (as X2). The performance target varies with water year type and is therefore shown at 0 as the horizontal red line. The Y axis shows the difference in measured fall X2 from the performance target: positive values indicate that outflow exceeded the target, negative values indicate that outflow was less than the target.

This performance target measures the volume of freshwater Delta outflow (or freshwater inflow into San Francisco Bay) and the resultant quantity and quality of low salinity, open water habitat during the fall (September-November; Figure 3). Declining freshwater outflows during this season are correlated with degraded open water habitat conditions and declines in delta smelt population abundance. The water year type dependent target level is designed to provide good open water habitat quality.

Stressors

The Delta ecosystem is adversely affected by both anthropogenic (e.g., entrainment, pollution) and biological stressors (invasive species). Entrainment and pollution are

directly responsive to management actions but the prevalence of invasive species in any ecosystem is as much an indicator of degraded habitat conditions resulting from loss of physical habitat, altered flow regimes, and impaired water quality as it is a driver of ecological problems. Therefore, carefully designed management and restoration actions to meet habitat, ecological processes, and water quality performance targets will also function to reduce the impacts of invasive species. Three performance measures address entrainment and contaminants.

Target 7. Limit annual entrainment losses of estuarine fish species to less than 5% of the population and to less than 2% for migratory fish species.

This performance target measures the percentage of the populations of estuarine and migratory fish species that are entrained into water diversions located in the Delta and Suisun Marsh. Entrainment of estuarine and migratory fishes at the more the 2000 water diversions in the Delta and Suisun Marsh can be a significant contributor to population declines in some years. The target levels are designed to reduce entrainment mortality to levels that are proportional to species population size and low enough to not cause the populations to decline.

Target 8. Limit total ammonia concentration to <0.07 mg/L and unionized ammonia concentration to <0.01 mg/l in Delta waters.

This performance target measures the concentrations of total ammonia and unionized ammonia in Delta waters. High concentrations of total ammonia can inhibit

phytoplankton production and high concentrations of unionized ammonia are directly toxic to fishes. The target levels are set at levels that eliminate these adverse effects.

Target 9. Reduce discharge of contaminants into Delta waterways and tributary rivers so that <5% of estuarine and anadromous fish populations exhibit evidence of toxic exposure and there are zero incidents of fish kills.

This performance target measures the prevalence of toxic contaminants in waters and sediments of the upper estuary, Delta, and tributary rivers by evaluating contaminant effects in fish species that are frequently and regularly sampled in the system. The target levels are designed to prevent incidents of direct mortality from contaminants and to reduce contaminant discharges to levels where only a small fraction of resident and migratory fish populations are exposed and/or affected.

More detail on the conceptual framework, specific rationales, and strategies for implementation of the ecosystem targets is contained in Attachment 1 (The Bay Institute, *Targets for protection of the Delta ecosystem as an integral part of a healthy estuary*).

Incorporating Ecosystem Targets into State and Local Permits and Licenses

The Delta ecosystem targets must drive decision-making about water policy and land use. To that end, the Strategic Plan should propose that:

1. The legislature should adopt these targets by statute as requirements to be incorporated in all relevant state and local permits and licenses, and as objectives for all relevant state planning and management activities.
2. The State Water Board should review and revise all relevant water rights permits, waste discharge requirements, and other relevant permits and licenses to comply with the appropriate ecosystem targets.
3. All state and local agencies with authority over land use in the Delta should review and revise all relevant general plans, permitting approval criteria, and pending permits and licenses to comply with the appropriate ecosystem targets.

Securing and Managing Additional Water for the Environment, Including a New Environmental Water Right

The current allocation of water for environmental purposes has not been sufficient to prevent collapse of the Delta ecosystem. While a number of factors are implicated in this collapse, the long-term, radical alteration of hydrologic patterns and decrease in Delta outflow under most conditions has been a primary driver of habitat degradation, rendering the Delta more vulnerable to secondary factors that would not be as likely to adversely affect a healthy estuary.

The ecosystem targets proposed above include several that will provide high quality hydrological conditions for estuarine species and habitats. For a variety of reasons, however, complying with these targets must be combined with the dedication of additional water supplies for Delta ecosystem protection that can be used in a flexible,

adaptively managed fashion in order to augment baseline regulatory protections. These additional water supplies can be provided under a new environmental water right and/or agreements that ensure environmental control over existing and new water supply infrastructure.

First, changes in operations and in storage and conveyance capacity in and upstream of the Delta, and in areas exporting water from Northern California, can undermine the protections afforded by any set of regulatory requirements or other targets, as evidenced by the recent shifts in the timing and amounts of export pumping and in the capacity to store exported water, which have played a major role in the pelagic fish population collapse. New environmental water would be used to avoid or offset such shifting impacts. Second, environmental conditions in the Delta are highly volatile as a result of both the accelerating effects of global warming and depressed population levels of native species. Episodic events that are not easy to predict may have a significant impact on the viability of estuarine species. New environmental water would be used to rapidly respond to emerging problems and fill gaps in the baseline regulatory requirements and other targets. Third, the amount of water currently dedicated to flexible environmental use under the Central Valley Project Improvement Act and the Environmental Water Account has been relatively trivial compared to the amount of water extracted from the Delta ecosystem and the amount of water needed to improve habitat conditions. New environmental water, if sufficient in magnitude, would allow for large-scale improvements in hydrological conditions for estuarine species on a real-time basis. In

summary, new environmental water would serve as a buffer between baseline protections and emerging, episodic and shifting impacts on estuarine species.

For these reasons, the Strategic plan should propose that:

1. The legislature should create a new environmental water right, i.e., a water right that allows for the appropriation of water for Delta ecosystem protection in order to augment minimum regulatory requirements.
2. Other arrangements should also be made to secure additional environmental control over existing and new water supply infrastructure.
3. A share of water stored and conveyed throughout the Delta watershed sufficient to achieve ecosystem targets (in combination with regulatory requirements) and provide an adequate buffer above attainment of targets should be secured to endow the new environmental water right and/or implement other environmental water arrangements. This environmental water should not be reliant on purchased water, since funding and purchase prices fluctuate from year to year, and long-term voluntary agreements are difficult to arrange.
4. The new environmental water should be managed by a new Delta Water Master (see below).

GOVERNANCE AND STRATEGIC FINANCE

This section provides greater detail on steps 4 through 8 as described on page 4.

Delta Water Master

Delta water operations – in-Delta diversions and interbasin water transfers – are managed on a real-time basis by water agencies primarily concerned with maximizing water deliveries while minimizing environmental compliance obligations. Regulators and resource agencies may set the baseline terms of compliance in permits but have limited or no ability to make direct decisions on a real-time basis regarding operational changes to avoid adverse habitat conditions or provide improved habitat conditions.

The creation of a new entity to act as a Delta Water Master (DWM) to manage a new environmental water right and oversee water operations in the Delta and interbasin transfers would correct this imbalance and elevate the place of the Delta ecosystem as a co-equal value in water management. In effect, the DWM would be able to flip the switches and turn the dials, just as water project operators do to maximize project deliveries today. The proposed DWM is the "functional equivalent" of the proposed Delta Water Management Commission that was included in our July 2007 recommendations to the Delta Vision Blue Ribbon Task Force.

The DWM would have the authority to:

1. Make releases from water stored or otherwise controlled by the new environmental water right to augment regulatory requirements. These releases could be used to directly improve habitat conditions or to offset reductions in diversions.
2. Require reductions in diversions and exports within the Delta and throughout its watershed to improve inflows, outflows, and water quality as needed.
3. Approve operational decisions by water project agencies involving interbasin transfers.
4. Operational decisions made by the DWM may be made in advance or in real time in response to biological and hydrological monitoring.
5. Administer fees imposed by the State Water Resources Control Board and/or directly impose fees.
6. Coordinate the activities of state and federal agencies that have legal responsibilities for fishery and water quality protection, including but not limited to the California Department of Fish and Game, the United States Fish and Wildlife Service, the National Marine Fisheries Service, and the U.S. Environmental Protection Agency. (This coordination function is not intended to have any effect on the existing statutory obligations of these agencies).

For more ideas on how the DWM could function, see Attachment 2 (Environmental Defense Fund*, Increasing the Flexibility of Environmental Water Supply Operations in the Delta*).

There are many ways to structure the DWM. Primarily, it is critical that a streamlined entity be created that would effectively and efficiently coordinate all agencies with legal

responsibilities for protecting water quality and natural resources in the Delta. Under one potential approach, the DWM entity would be managed by an executive director with the authority to hire sufficient staff to perform the functions described above. The executive director would be appointed by the State Water Board, and all decisions of the DWM would be subject to the concurrence of the Board (or its executive director). Under an alternative approach, the DWM entity would be overseen by a board consisting of members filling specific positions with expertise in Delta agriculture; Delta communities; export water use; commercial and recreational fishing; communities downstream of the Delta; environmental justice; water quality; public interest environmental advocacy; and aquatic biology. The members would be appointed by the Governor (5), the President Pro Tem of the Senate (2) and the Speaker of the Assembly (2). Their authority would be delegated from the State Water Board, and their decisions would be subject to the oversight and concurrence of the State Board.

The DWM would have the authority to impose new fees and/or would administer fees collected by the State Board, which already has the authority to impose fees. These fees would be imposed in the following areas:

Ecosystem Restoration: A fee for ecosystem restoration is required to provide more complete mitigation for the system-wide impacts of water diversions in the watershed. The fee should be imposed on all water diverted from the watershed. However, this state fee should take into account the contributions made to the Central Valley Project Restoration Fund for a system-wide mitigation program. The goal of the ecosystem restoration fee is to

create an equitable, watershed-based, state Bay-Delta restoration fund parallel to that created for the Central Valley Project by the Central Valley Project Improvement Act. These funds should be awarded by the DWM to restoration program managers such as the Department of Fish and Game.

Delta Flood Management: A fee on water exported from the Delta should be created to provide funding for flood management efforts in the Delta that produce direct reliability benefits for the exporters. These funds should be awarded by the DWM to flood management entities such as the Department of Water Resources Division of Flood Management to implement portions of the State Plan of Flood Control (currently under development) that provide direct reliability benefits for the exporters. This fee should be designed to ensure that the flood management program is consistent with ecosystem restoration goals.

Science: A fee to provide ongoing, reliable support for the existing Bay-Delta science program would allow the state to better understand the impacts of water management and allow more effective management over time.

DWM Management: Fees should be imposed to fund the activities of the DWM. These activities will include operational costs, staffing costs, and potentially costs of storing and releasing environmental water. The DWM will not buy or sell water supplies in the normal course of business, however, so it is not expected that fees will be collected for this purpose.

Land Use Regulation

In our July 2007 recommendations, we proposed the creation of a Delta Conservation and Development Commission with authority to regulate land use, protect and restore habitat, and address water quality, on the pattern of the existing Bay Conservation and Development Commission. (This entity could perhaps also be established by modifying the authority of the existing Delta Protection Commission). This element should be included in the 2008 Strategic Plan.

Special Status for the Delta

In our July 2007 recommendations, we proposed state and federal designations for the Delta designed to strengthen the "sense of place" in the Delta, increase public awareness of this unique resource, and drive efforts to acquire, manage and restore habitat areas in protected zones throughout the Delta. Specifically, the Strategic Plan should propose that:

1. The state should, working with Delta communities, create a Delta State Park. This park would also serve the purpose of unifying the different state property interests in the Delta. The state is already an extensive land owner in the Delta. Over time, particularly as restoration efforts proceed, existing state land (e.g. Sherman Island) and additional lands that will be purchased by the state to facilitate ecosystem restoration should be unified as separate units in a single state park. The Sonoma Coast State Park provides an example of a state park composed of several different units, but retaining a single identity and unified management.

2. The federal government should, working with Delta communities, designate the Delta as a National Heritage Area. This designation would reflect the broad cultural, historic and natural values of the Delta. It is likely that most public purchases in the Delta in the near future would be made with state, not federal funds. This fact makes the NHA designation particularly appropriate, as the NHA model is not based on federal ownership and management. The NHA designation, however, could make a significant contribution to increasing public awareness of the Delta. See http://www.nps.gov/history/heritageareas/FAQ/INDEX.HTM for more information.

Strategic Finance

Implementing an effective Strategic Plan that successfully addresses a full range of Delta issues will require an extremely large financial investment totaling tens of billions of dollars over the life of the plan. Securing that funding will be a major challenge. Meeting that challenge should not wait until after the plan is written.

Issues related to economics and finance have proven to be important challenges for other water policy efforts in California. The CALFED Bay-Delta Program stumbled over the task of developing a realistic financing plan. Development of a detailed financing plan was not begun until years after the CALFED Record of Decision (ROD) was finalized. The legislature pressured the CALFED Program to develop a financing plan to guide the implementation of the ROD. The CALFED Program did some good work in this area, but the plan was never finalized. As a result, key elements of the CALFED ROD, such as the levee program, were dramatically underfunded. The failure of the CALFED Program regarding

financing contributed to the legislature's loss of confidence in the program and its ultimate failure. The legislature is currently considering SB 1102 (Machado), which would disband the CALFED Program. In 2006, the Governor proposed the creation of a Resource Investment Fund (RIF) to finance water management programs. The RIF proposal failed to win approval in the legislature, in large part due to opposition from water users who did not want to pay into a RIF without knowing how those funds would be spent.

In short, the CALFED ROD was, in some ways, an investment plan without a finance plan. On the other hand, the RIF was a finance plan without an investment plan. With a price tag in the tens of billions of dollars, an effective Delta Vision implementation plan must address both what investments are needed, and how they will be financed. Economics and financing will be central to the success or failure of the Delta Vision strategic plan. Given the scope of this effort, a focus on economics is essential to ensure that the plan is as cost-effective as possible. An early focus on financing is also essential to maximize the chances that the plan will be successfully implemented, rather than merely sit on a shelf gathering dust.

These observations have led to the following initial conclusions, which have shaped our subsequent recommendations.

Businesses and water users seek the most cost-effective solutions, but agencies have not always done so. Water users are very focused on the cost-effectiveness of any benefits they might receive from an investment they are considering. However, policy discussions in the legislature and state and federal agencies regarding potential elements of a comprehensive

Delta plan frequently fail to address the issue of cost-effectiveness. Without a focus on the cost-effectiveness of key elements of a Delta Vision plan, there is a greater risk that water users will be unwilling to invest in that plan. The state does have a successful model that Delta Vision can build on. For example, the state's focus on Integrated Regional Water Management in the last several years has helped the state work collaboratively with local agencies to direct state investments to cost-effective strategies that local agencies are eager to invest in.

In the future – unlike the past - most of the funds to address issues related to the Bay-Delta, particularly to ensure adequate future water supplies, are expected to come from water users, not federal or state general funds or bonds. For example, in testimony before the Senate Committee on Natural Resources and Water on March 11, 2008, the Legislative Analyst reported that "local matches and other local direct expenditures likely outplace state funding for water conservation" and that "local funding for groundwater management far exceeds state local assistance funds by more than 2 to 1." While it is a mark of progress that local beneficiaries are expected to pay for more than two-thirds of the cost of groundwater development, we generally believe that beneficiaries should pay for 100% of benefits received.

Economics and finance will play an important role in the transition from a focus on developing traditional water projects to a focus on improved management and efficiency. We do not mean to suggest that there will be no significant infrastructure investments in the future. However, there is remarkable agreement around the conclusion in the California

State Water Plan Update (2005) that the new water supplies needed to meet California's future water needs will come largely from efficiency, water recycling and improved groundwater management (e.g. groundwater clean-up), not from new surface storage. Almost by definition, effective efficiency programs must focus on cost-effectiveness and financing issues. Internalizing costs are an important part of that process. The energy field has undergone this transition in the last 20 years, resulting in a much sharper focus on cost-effectiveness and user-financing. Environmental limits on the historic pattern of steadily increasing Delta diversions, along with the pressure of global warming on water systems, will, over time, increase the need to focus on economics and finance. Simply put, California is no longer in an era of cheap, abundant water.

With these conclusions in mind, we offer the following recommendations regarding finance and economics.

An integrated approach to economics and financing should be developed as early as possible. Economics and financing are not merely implementation issues to be considered at the end of the process. They should be integrated into the planning process from the start, because they will likely shape the substance of the plan. For example, an early focus on financing will lead potential funders to focus on the cost-effectiveness of proposed projects. The result will be a more effective, less costly plan that is far more likely to be implemented.

A meaningful "beneficiary pays" approach is key. As stated above, water user funding will likely exceed state and federal funding in many areas of the Delta Vision plan. Given this

fact, and given that water users will be unwilling to pay for benefits that their neighbors would receive, it is essential that the Strategic Plan include a meaningful "beneficiary pays" approach to financing. Our remaining recommendations will focus largely on the elements of such an approach.

For example, however Delta conveyance issues are resolved, it is anticipated that levee repair will cost many billions of dollars. Repairing levees would benefit highways, railroads, power transmission, shipping, local communities, and many other interests. To ensure fairness and cost-effectiveness, the strategic plan should identify mechanisms for distributing the costs of levee repair in a rational and equitable way.

The focus should be on cost-effectiveness, including the full cost of protecting environmental resources. There are many ways to meet our future water needs (e.g. efficiency, transfers, conjunctive use, water recycling, traditional water projects.) Likewise, there are different ways to improve flood management in the Delta (e.g. land use decisions, flood bypasses, levee improvements). A focus on cost-effectiveness will help decision-makers select among alternatives and increase the willingness of water users to invest in that plan. Any public funding for water supply should be focused on cost-effective water strategies that are aligned with the priorities of water agencies for investing their own funds. A focus on cost-effectiveness necessarily requires that water strategies are designed in a process that includes a careful evaluation of competing approaches.

Public funds should be dedicated to achieving well defined public benefits. It is not enough merely to promise public benefits. The Strategic Plan should clearly define what constitutes a public benefit. For example, mitigation is not a public benefit. Increasing the reliability of supply for one set of water users is not a public benefit. This step is essential to equitably apportion costs.

Proposals to develop new storage capacity, operated to provide environmental benefits, are essentially mitigation, as they are an admission that operation of existing facilities has over-manipulated the natural hydrograph. The cost of developing any new storage capacity dedicated to the environment should appropriately be borne by user fees rather than taxpayer funds or general obligation bonds. This will ensure that the price of water will better reflect the cost of extracting it for consumptive use.

Unfortunately, there is a long history of unfulfilled promises of public benefits from water projects. Therefore, the Strategic Plan should recommend the creation of effective assurances that provide guarantees that public benefits will be achieved. Water projects have routinely written water contracts with water contractors. These contracts are intended to provide water users with some predictability regarding the allocation of water supply from a particular project. However, water projects have generally not made similar commitments regarding the public benefits that are used as justification for public funding. To the extent that state or federal funds are invested in water projects in the future, as a result of promised public benefits, new enforceable mechanisms should be required that provide some assurance that public benefits will be achieved. These assurances can take several forms:

- Enforceable regulatory commitments.
- Enforceable water efficiency and recycling targets to ensure reasonable use,
- Contracts, including private enforcement agreements and commitments in bonds.
- Governance structures, including ownership interest.

Designing a "beneficiary pays" financing approach for large infrastructure projects. A careful approach is particularly important for large infrastructure projects, because of potential environmental impacts, the large amount of funding required, and the risk of stranded investments in the planning phase if needed financing for implementation fails to appear. Specifically, the Strategic Plan should condition the consideration and selection of any large infrastructure project on the following:

- Requiring a completed finance plan as a precondition for design and construction phases of a large capital project.
- Requiring local agencies to prepare a finance plan to pay the local share of a capital project.
- Requiring participation from potential beneficiaries in funding for initial studies.
- Establishing a clear "without project" baseline from which to measure project benefits.
- Assigning cost shares proportionally to expected benefits. As stated above, public benefits of mitigating project impacts should be subsidized by water user fees.

Learning from California's pioneering energy and climate programs. The Delta Vision Task Force should consider the approach to economics and finance in California's energy and climate programs. We recommend that the Task Force consider incorporating the following concepts in the implementation plan:

- The creation of a loading order and public goods charge. These policy tools guide energy investments to cost-effective solutions and provide use-based financing. They have played a major part in California's dramatic progress on energy efficiency. (See Natural Resources Defense Council, *Transforming Water Use: A California Water Efficiency Agenda for the 21st Century*, previously submitted to the Task Force.)
- The energy benefits of water conservation and other tools that could increase regional self-sufficiency could provide a significant source of new funding.
- The carbon sequestration benefits of wetlands restoration in the Delta, particularly on subsided Delta islands, could provide an additional source of funding.

Create a system of equitable user fees to internalize externalities. User fees are essential to ending the "free rider" syndrome and ensuring that all users address impacts to which they contribute and support programs from which they benefit. There are many examples of such fees. (e.g. California's commercial salmon fishermen purchase a salmon stamp to support the health of that fishery.) The Strategic Plan should propose a carefully designed water use fee.

A water user fee should be primarily based on volume and applied to all water diverted within the Bay-Delta watershed for consumptive use on farms and in cities. It may also be appropriate to incorporate diversions for hydropower as part of the water user fee.

For example, Delta Vision has acknowledged that all water users in the watershed contribute to the degraded state of the Delta ecosystem. Granted, some water projects are a larger cause than others. However, all water users should contribute to the effort to restore the Delta environment. The Central Valley Project does collect a user fee for a system-wide program to mitigate for the impacts of the project. Other water users in the watershed, however, contribute little or nothing to address Delta issues. User fees would be an important complement to public funding for this effort and are likely to prove to be essential to the long term success of any Delta restoration effort.

Similar user fees could be developed to provide support for Delta flood management from the export water users who depend on Delta levees. Likewise, a user fee could be designed to support an ongoing science program for the Bay-Delta ecosystem. (See recommendations above regarding the Delta Water Master).

Use fees must be designed carefully to tie fees to specific impacts and benefits. Likewise, fees must be carefully designed to address the risk that the general fund deficit could result in pressure to divert revenue from these user fees to other purposes. A system of user fees must not be allowed to become a de facto tax, providing revenue for the state's general fund. (This recommendation is also discussed in our governance recommendations.)

Look for opportunities to reduce water subsidies that increase pressure for diversions in the Bay-Delta watershed. Water resources throughout the Bay-Delta watershed are substantially over-allocated. Moving away from historic water subsidies could be an important part of a Delta strategy. For example, expiring CVP water contracts provide an opportunity for the Bureau of Reclamation to move more toward realistic cost- and market-based pricing. Reducing such subsidies could provide increased incentives for users to invest in efficiency and decrease pressure on the Delta.

TARGETS FOR PROTECTION OF THE DELTA ECOSYSTEM AS AN INTEGRAL PART OF A HEALTHY ESTUARY

1. Introduction

Restoration of the Delta ecosystem so that it functions as an integral part of a healthy estuary is one of two co-equal goals of the Delta Vision process (Delta Vision Recommendations 1 and 3). Achieving this goal will require:

1) establishing appropriate and measurable **ecosystem performance targets** set at levels sufficient to achieve and sustain the desired levels of ecosystem functions;

2) identifying **ecosystem management and restoration strategies** that, based on scientific understanding of the existing system and projected future conditions, will contribute towards achieving the ecosystem performance targets; and

3) establishing an **adaptive management** process for regular evaluation of progress towards the ecosystem performance targets and ecosystem response to implemented management and restoration actions.

This attachment identifies ecosystem performance targets to guide development and implementation of the Delta Vision's Strategic Plan for restoring the Delta ecosystem.

2. The Restoration Recipe, Performance Targets, and the Strategic Plan

The Delta Vision Ecosystem Work Group (EWG) has developed a simple framework to describe the relationships between desired ecosystem characteristics and the physical and biological problems and stressors that drive and/or are indicative of poor ecosystem function. We used the EWG's "restoration recipe" to identify ecosystem performance targets for the overarching restoration goal and for the broad categories of restoration of habitats and ecological processes and

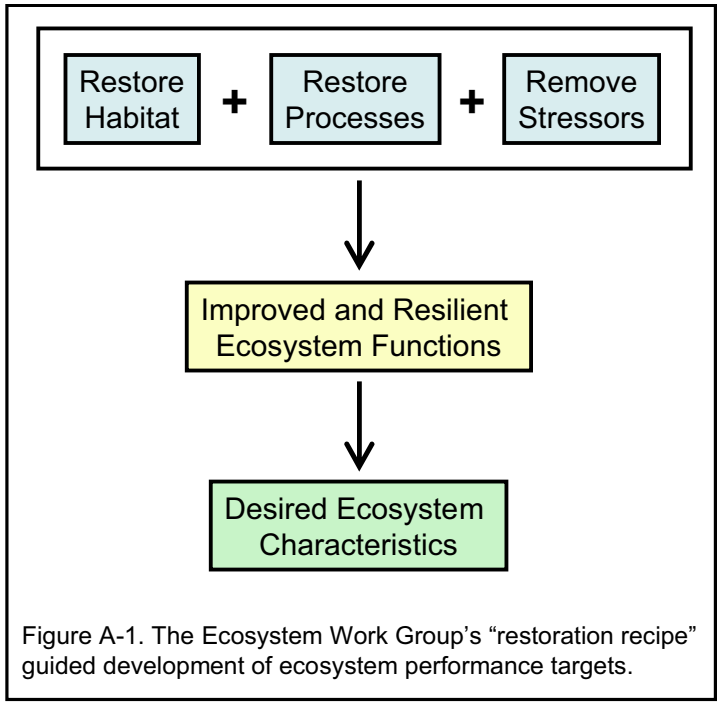

Figure A-1. The Ecosystem Work Group's "restoration recipe" guided development of ecosystem performance targets.

removal of stressors that are needed to reach the desired level of ecosystem function (Figure A-1). We then used this analysis to identify a suite of ecosystem management and restoration actions and strategies that can be implemented to achieve the performance targets and the Delta Vision goal for Delta ecosystem function.

3. Metrics, Rationale and Target Levels for the Ecosystem Targets

For the Delta to function as an integral part of a healthy estuary it must support viable and resilient populations of estuarine species, provide a migration corridor for migratory species, and support human services such as flood protection, water quality, and recreation. We have developed nine quantitative performance targets organized into four broad categories of ecosystem attributes that, when fully met, will provide the level of ecosystem function necessary to meet the Delta Vision goal. In addition, performance targets for habitats, ecological processes, and stressors have been explicitly developed to help guide development of the Delta Vision Strategic Plan for ecosystem restoration (Visions Recommendations 1, 3, 7, 9 and 11) and to be direct measures of implementation restoration and management actions that will be included in the Delta Vision Strategic Plan.

A. Viable and Resilient Populations

The Delta Vision's overarching goal that the Delta function as an integral part of a healthy estuary requires that it be able to support viable, resilient populations of estuarine species. The Delta Vision Ecosystem Work Group (EWG) has identified performance targets for multiple species groups (e.g., fishes and birds). As a simpler and more appropriate alternative, we propose a single target based on estuarine fish population abundance.

Target 1. Restore abundance of estuarine fish species to greater than 104% of average levels measured during the 1967-1991 period.

Metric: Abundance of delta smelt, longfin smelt, and splittail in the Delta and upper San Francisco Estuary is measured annually by the California Department of Fish and Game (CDFG) Fall Midwater trawl Survey. Relative abundance for each of the three species (Figure A-2) is calculated from their annual Fall Midwater Trawl Abundance Index (log_{10} transformed to stabilize the wide inter-annual variances) as:

Relative abundance (species) =

[(log FMWT Index)/(mean log FMWT Index for 1967-1991)]*100

The performance measure for the three estuarine species combined is calculated as the average of the three relative abundance values (see Figure 1).

Rationale: Each of these estuary-dependent fish species uses the Delta and San Francisco Estuary in different ways. Delta smelt are year-round residents of the Delta and upper estuary. Longfin smelt spawn in the lower Delta and spend the rest of their two-year life span distributed throughout the estuary and nearshore coastal waters. Splittail use seasonally inundated floodplains in the lower watershed for spawning and the upper estuary for the rest of their life span.

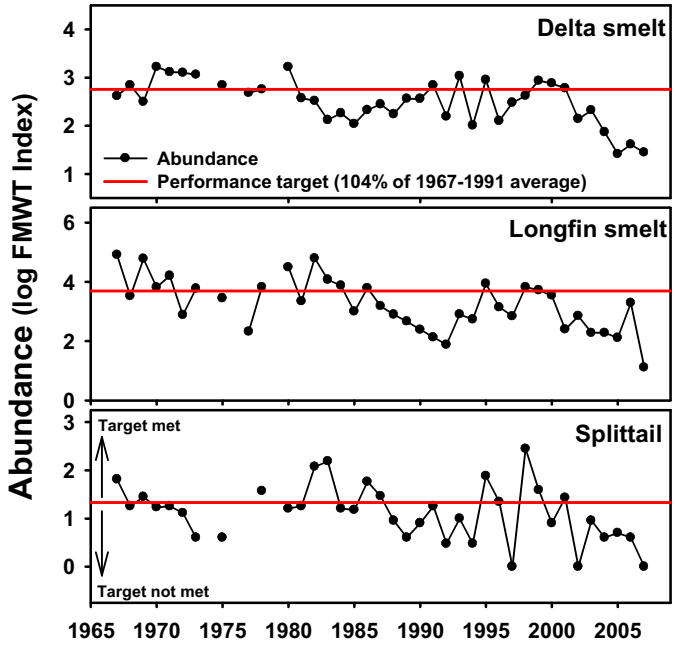

Figure A-2. Abundance of three native estuarine species relative to the 1967-1991 average abundance.

Abundance of native fish species within an ecosystem is a well-documented indicator of aquatic ecosystem health, particularly in urbanized watersheds (Wang and Lyons, 2003; Harrison and Whitfield, 2004). Native fishes are more abundant in a healthy aquatic ecosystem than in one impaired by altered flow regimes, toxic contamination and reduced nearshore habitat, the usual consequences of urbanization and water development. In addition, in the San Francisco Estuary and the Delta, the population abundances of a number of native (and non-native) estuarine fish species are strongly correlated with specific seasonal environmental conditions associated with freshwater inflow

and water quality (e.g., salinity, turbidity; Jassby et al., 1995; Kimmerer, 2002; Feyrer et al., 2007).

Protection and recovery of selected native fish species, as well as important commercial and recreational species like Chinook salmon and striped bass, has been and will continue to be the principal regulatory and policy driver for management of the San Francisco Estuary, the Delta and the Sacramento-San Joaquin watershed. Two of the native species included in the performance measure are presently listed under state and/or federal Endangered Species Acts and the third, splittail, was listed as threatened until the listing was withdrawn in 2004. Recovery of these species, as mandated by these laws, will require achieving and maintaining higher population levels than those measured in recent years.

Target level: Abundance greater than the 1967-1991 average (expressed as the average plus 1 standard error, or 104% of the 1967-1991 average) represents an abundance level at which estuarine fish populations are viable (i.e., at low risk of extinction) and resilient (i.e., capable of responding to variations in environmental conditions without collapsing. The 25 year-long target reference period, 1967-1991, includes wide variations in hydrology (e.g., very wet and very dry years as well as two multi-year droughts) and large scale climate conditions (e.g., at least two Pacific Decadal Oscillation regimes). It is also the same reference period as that established by the federal Central Valley Project

Improvement Act (CVPIA) for production goals for anadromous fishes in the watershed. During this period, the populations of the three species were resilient with their abundance levels varying predictably with environmental conditions (e.g., seasonal freshwater flows; see Fig A-5 below) and anthropogenic and biological stressors (e.g., high levels of water diversion, exotic species invasions). The abundance target was met 9 of 22 years (41%) during the 1967-1991 period and 3 of 16 years (19%) during the 1992-2007 period (see Figure 1). Abundance levels below the target measured in the 1990s and 2000s prompted listing under state and federal Endangered Species Acts for all three species, a strong indication that such population levels were not considered viable or sustainable by regulatory agencies. This target complements but does not replace existing statutory and regulatory targets for Bay-Delta species, including the federal and state requirements to double natural production of Chinook salmon and other anadromous fish species.

B. Habitats

Three of the management and restoration performance measures and targets are designed to restore the extent and diversity of physical habitat types and the complexity of channel configurations by restoring specific acreages of tidal marsh (Target 2), uplands and seasonal wetlands (Target 3), and floodplains (Target 4). While the quantitative targets are based on habitat area, four important aspects of habitat quality and function should be considered when

planning and implementing projects, and when evaluating progress towards the performance targets.

Bigger is better: Habitats that extend over large areas provide greater function, support larger numbers and greater diversity of species, and therefore have higher ecological value than small area habitats.

Connectivity is essential: Habitats that are physically connected along long interfaces to other habitat types (e.g., tidal marsh and upland habitats) provide greater function, support larger numbers and greater diversity of species, and therefore have higher ecological value that isolated habitats.

Distribute habitat broadly throughout the Delta and upper estuary: Habitats that are spatially distributed throughout the Delta and upper estuary will provide benefits to greater numbers and diversity of species than habitats concentrated in one or only a few regions (e.g., floodplain restoration in the north and south Delta will benefit both Sacramento and San Joaquin basin salmonids).

Plan for durability and resilience: Restored and/or protected habitats should be located in places that are not subject to natural (e.g., sea level rise) or anthropogenic (e.g., urbanization) loss or degradation over time.

Target 2. Restore 80,000 acres of tidal marsh habitat in the Delta and 50,000 acres of tidal marsh habitat in Suisun Marsh.

Metric: Tidal marsh area (acres) is measured as the total area of vegetated lands with elevations ranging from mean lower low water to mean higher high water that are fully exposed to tidal action and are connected to the other tidal marshes, the Delta and/or the estuary by waterways.

Rationale: Tidal marshes provide habitat for estuarine and migratory species (including some of the target estuarine fish species, as well as native plants, amphibians, reptiles, resident and migratory birds, and mammals), increase primary and secondary productivity in the estuary, export of carbon and food organisms to the Delta and estuary, and improve water quality by filtering contaminants from surface runoff and tidally exchanged waters. Nearly all historic tidal marsh habitat has been lost from the Delta and upper estuary.

Target level: The performance targets for the Delta and Suisun Marsh represent the total areas of land with the appropriate elevation in each region and are identical to those proposed by the EWG (see Figure 6 in the EWG's April 24, 2008 Draft Recommendations for Restoring the Delta's Ecosystem).

Target 3. Restore 130,000 acres of terrestrial grasslands and seasonal wetland complexes in the Delta and 5000 acres in Suisun Marsh

Metric: Upland terrestrial grasslands and seasonal wetland area (acres) is measured as the total area of lands in the Delta and Suisun Marsh with elevations above mean higher high water that support terrestrial grasslands and/or season wetland complexes.

Rationale: These habitats support wildlife, improve water quality by filtering contaminants in surface runoff, and provide accommodation space for sea level rise.

Target level: The performance targets, 130,000 acres in the Delta and 5000 acres in Suisun Marsh, represent the total areas of land with the appropriate elevation in each region and are identical to those proposed by the EWG (see Figure 6 in the EWG's April 24, 2008 Draft Recommendations for Restoring the Delta's Ecosystem).

Target 4. Restore 60,000 acres of floodplain habitat to seasonal inundation for a minimum of 45 consecutive days at least once every two years.

Metric: Floodplain habitat is measured as acres inundated by flow from adjacent rivers for 45 consecutive days during the February through May period.

Rationale: Throughout the lower watershed, historic floodplains have been isolated from their rivers by levees. Even in managed floodways like the Yolo Bypass, altered river flows and bypass weir operations prevent the floodplain from being inundated in most years (Figure A-3). Seasonally inundated floodplains provide spawning habitat for splittail (one of the target estuarine fish species), an enhanced migration corridor for juvenile salmonids, robust primary and secondary productivity for export to the Delta, and improved flood protection in adjacent and downstream areas (Sommer et al. 1997, 2001).

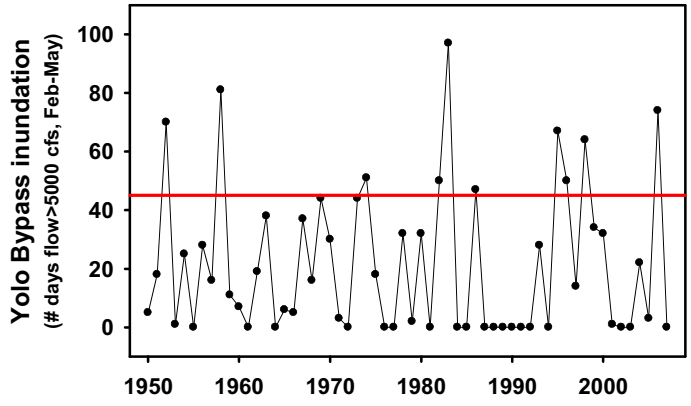

Figure A-3. The number of days during the February-May period that the Yolo Bypass was flooded (as indicated by >5000 cfs discharge from the Yolo Bypass into the Delta). The horizontal red line indicates the performance target of 45 consecutive days.

Target level: The performance target, 60,000 acres with inundation for 45 consecutive days or longer every other year during the late winter or spring, is designed to support the splittail spawning, juvenile salmon migration, and productivity objectives. The acreage target represents the total area of current functional floodplain in the Yolo Bypass and the Cosumnes Reserve but does not preclude restoration of additional floodplain area in other regions of the Delta (e.g., adjacent to the lower San Joaquin River).

C. Ecological Processes

Ecological processes in the Delta include transport of materials (e.g., by flow and tidal exchange across connections between different habitat types), primary and secondary productivity, seasonal variability in environmental conditions (e.g., flow, location and area of low salinity habitat, temperature), and disturbance (e.g., flood events). Some of these processes are provided by the natural function of specific habitat types (e.g., tidal marshes or floodplains), therefore there is some overlap between habitat and ecological processes performance targets (see Table A-4 below). In contrast to the approach used by the EWG, we have addressed the issue of estuarine open water habitat quantity and quality in terms of an ecological process with two performance targets (Targets 5 and 6) that measure that amounts of seasonal freshwater inflow and the location of the low salinity habitat (as denoted by X2, location of the 2 ppt isohaline in kilometers from the Golden Gate), rather than in terms of aerial extent of low salinity habitat

(i.e., acres). Although the area of low salinity habitat generally increases with increasing amounts of freshwater inflow (i.e., lower X2), current management of freshwater inflows to the estuary is based on a well-documented relationship between inflow volume and X2, is tightly controlled by the state and federal water projects, and strongly affects water supply reliability. However, changes in Delta geometry, including large-scale tidal marsh restoration, channel reconfiguration, or a levee failure and subsequent island flooding, as well as sea level rise in the longer term, will change this relationship. Therefore, the relationship between freshwater inflow and open water habitat characteristics, including amount, surface area to depth ratios, and water circulation patterns (e.g., water velocity, mixing v advection) should be determined to allow quantitative flow and habitat targets to be developed for future Delta configurations.

Target 5. Restore spring Delta outflow to provide low salinity habitat in Suisun Bay, with average February-June X2 values ranging from less than or equal to 70 km from the Golden Gate in critically dry years to less than or equal to 58 km in wet years.

Metric: The quantitative performance target is expressed as the average February-June X2, the location of the 2 ppt isohaline in kilometers from the Golden Gate, and varies with water year type (Table A-1).

Table A-1. Spring Delta outflow target for different water year types.

Water year type	Wet	Above normal	Below normal	Dry	Critically dry
Target (av. Feb-June X2, km)	≤58	≤61	≤64	≤67	≤70

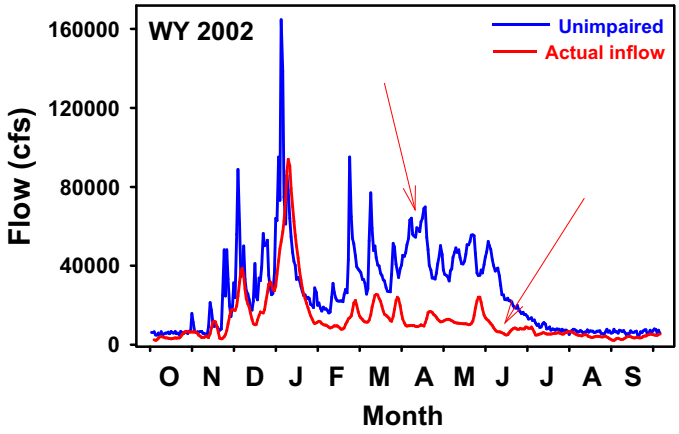

Figure A-4. Actual Delta outflow compared to estimated unimpaired runoff in the estuary's watershed. The greatest alterations in outflow from dam and Delta export operations occur during the spring (Feb-June).

Rationale: Historically, two thirds of total annual Delta outflow (i.e., freshwater inflow to San Francisco Bay) occurred during the spring, as snow in the estuary's mountain watershed melted and filled the Delta's tributary rivers. Prolonged high flows during this period are still the dominant feature of estuary's hydrograph but, as a result of upstream dams and Delta water export operations, spring is also the period of the greatest anthropogenic alterations in freshwater inflows to the estuary (Figure A-3). Spring outflows have been cut by more than 50% in half of all years since 1992 and in five of the past eight years. Many estuarine and anadromous fish and invertebrate species depend on prolonged high freshwater outflows during the spring to trigger migration and spawning, provide large areas of ecologically important low salinity habitat, and facilitate downstream transport of food organisms and young fishes. Abundance and survival of a number of estuary-dependent

species (including two of the three fish species included in Target 1) is higher when springtime X2 is located in Suisun Bay (50-60 km) and significantly lower when spring outflows are low and X2 is farther upstream. In the past 41 years, spring X2 has been upstream of 70 km (i.e., low inflow) in 40% of years.

Target level: The target levels are based on statistically significant relationships between spring X2 and estuarine fish population abundance (Figure A-5). Despite large ecological changes in the estuary (e.g., declines in food availability, establishment of invasive species such as *Corbula*), this strong relationship between spring flow and estuarine fish abundance has persisted although fish population levels are lower. The target levels for spring outflow in critical and dry years are set at levels that corresponded to minimally achieving the estuarine fish abundance target (Target 1) during the 1967-1991 period. The target levels for wetter years

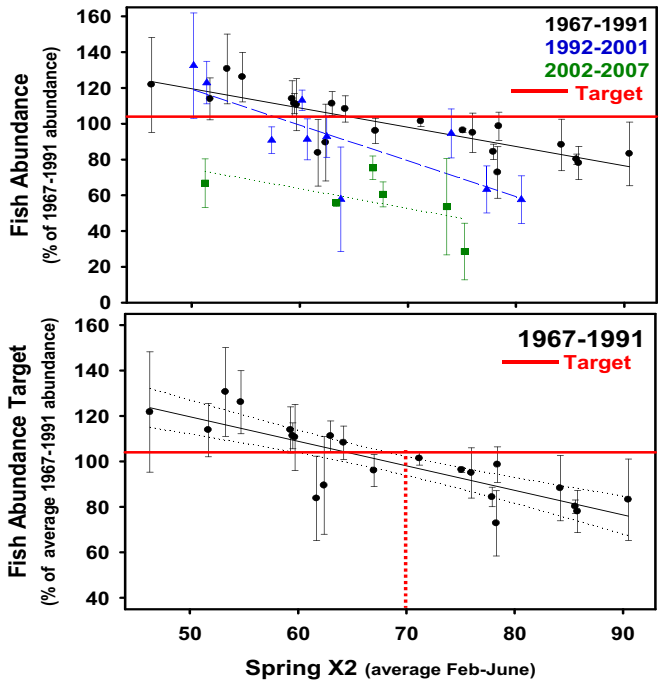

Figure A-5. The relationship between estuarine fish abundance (expressed as the percentage of the average 1967-1991 abundance; Target 1 is shown as the horizontal red line) and spring freshwater inflow (as X2). The top panel shows that, although overall abundance has declined, this statistically significant relationship is still strong despite large ecological changes in the estuary in recent years. The bottom panel shows how the relationship was used to determine the spring inflow target level necessary to achieve the fish abundance target.

that require higher spring outflows are set to ensure intra- and inter-annual variability in freshwater inflows to the estuary and to provide ecological conditions that are more favorable for native species and less favorable for invasive species that thrive in stable ecosystems with less disturbance. The spring outflow target was met five of 25 years (20%) during the 1967-1991 period and six of 16 years (38%) during the 1992-2007 period (see Figure 2).

Target 6. Restore fall Delta outflow to provide low salinity habitat downstream of the Sacramento-San Joaquin River confluence, with September-November average X2 values to less than 80 km in all years except critically dry years.

Metric: The quantitative performance target is expressed as X2, the location of the 2 ppt isohaline in kilometers from the Golden Gate, and varies with water year type (Table A-2).

Table A-2. Fall Delta outflow target for different water year types.

Water year type	Wet	Above normal	Below normal	Dry	Critically dry
Target (average Sept-Nov X2, km)	<80	<80	<80	<80	<83

Rationale: Recent research has demonstrated the decline of Delta outflow (i.e., freshwater inflow to San Francisco Bay) during the fall, the resultant decline in open water habitat quality and quantity, and the importance of providing this

habitat for delta smelt, a native estuarine resident species listed under state and federal Endangered Species Acts and one of the fish species included in Target 1 (USFWS 2006; Feyrer et al. 2007). Low freshwater outflows that result in X2 locations upstream of 80 km during the fall correspond to poor habitat conditions for maturing adult fish and lower abundances of juvenile fish measured the following spring. Recent lower fall outflows have also corresponded to the increased upstream distribution of the invasive clam *Corbula*, which prefers stable, low salinity conditions.

Target level: The target levels are based on statistically significant relationships between fall X2, open water habitat quality and quantity for delta smelt and population abundance of juvenile delta smelt measured the following spring, and are set at levels that correspond to good open water habitat quality. The fall outflow target was met 16 of 25 years (64%) during the 1967-1991 period and four of 16 years (25%) during the 1992-2007 period (see Figure 3).

D. Stressors

The Delta ecosystem is adversely affected by both anthropogenic (e.g., entrainment, pollution) and biological stressors (e.g., invasive species). Entrainment and pollution impose increased mortality rates on desirable species and their food, and sub-lethal levels of contaminants can change species' distributions, impair growth, behavior and reproduction, and cause

developmental anomalies. In addition, toxic contaminants can be transferred to people via consumption of Delta fish and waterfowl. Three performance targets address entrainment (Target 7) and contaminant stressors (Targets 8 and 9). Invasive species that alter habitat conditions and prey upon and/or compete with native species are an important stressor in the Delta ecosystem. But, while entrainment and pollution are directly responsive to management actions, there are few effective active control measures (e.g., poisons, physical removal, harvest) for eradication and/or reduction of non-native species in aquatic ecosystems that do not adversely affect native species and communities. In addition, the prevalence of non-native species in any ecosystem is a well-documented indicator of degraded habitat conditions resulting from loss of physical habitat, altered flow regimes, and impaired water quality (May and Brown 2002; Meador et al. 2003). Therefore, carefully designed management and restoration actions that address these problems can also function to reduce the prevalence and adverse impacts of invasive species. We do not recommend separate performance target(s) for this stressor.

Target 7. Limit annual entrainment losses of estuarine fish species to less than 5% of the population and to less than 2% for migratory fish species.

Metric: Currently, entrainment is monitored at only the large federal and state water export facilities in the Delta. Because abundance is measured differently

for estuarine and anadromous fish species, measures of entrainment in relation to population size will also differ. For estuarine species such as delta smelt, the most practical performance target is a ratio of the number of fish entrained to the previous year's Fall Midwater Trawl Index. For salmonids, numbers of juvenile fish can be estimated from adult escapement numbers, and the performance target would be expressed as a percentage. Initially, this performance target will be calculated using entrainment data from the federal and state water export facilities but, as additional monitoring comes on line, entrainment results from those facilities should be included in calculations of the overall entrainment rate.

Rationale: There are more than 2000 government, agricultural, urban and industrial water diversions located in the Delta and Suisun Marsh. Collectively, Delta diversions can remove more than 65% of total Delta inflow per day. Since the mid-1970s, average daily diversion rates have exceeded 50% in 12 years. Recent research suggests that entrainment mortality of estuarine and migratory fish species can be a significant contributor to population declines in some years.

Target level: The target is designed to reduce direct mortality of fishes at water diversions to levels that are proportional to their population size and are sustainable (i.e., will not cause the population to decline). The quantitative performance target for estuarine fish whose populations are measured using the Fall Midwater Trawl Survey different fish species is expressed differently,

depending on the method(s) used to estimate population size. Table A-3 shows example metrics and targets for two species and Figure A-6 shows target results for delta smelt.

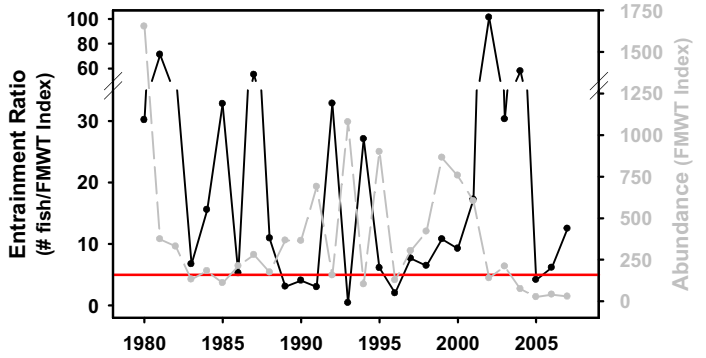

Figure A-6. The entrainment ratio (black line and symbols) and the Fall Midwater Trawl Abundance Index for adult delta smelt. The horizontal red line shows the entrainment performance target.

Table A-3. Example entrainment metrics and targets for estuarine and migratory fish species.

Species	Metric	Entrainment Target
Delta smelt	(# salvaged per year/FMWT Index)	<5.0
Chinook salmon	(#salvaged/#juvenile fish)*100	<2%

Target 8. Limit total ammonia nitrogen concentration to <0.07 mg/L and unionized ammonia concentration to <0.01 mg/l in Delta waters.

Metric: Water samples are regularly collected throughout the Delta and total ammonia nitrogen concentration (mg/L of NH_3-NH_4^+) can be measured using a variety of methods. Unionized ammonia concentration (mg/L) is usually calculated from the total ammonia concentration, pH and water temperature conditions.

Rationale: High concentrations of ammonium ion (NH_4^+), the dominant form of ammonia nitrogen in Delta and estuarine waters, can inhibit phytoplankton production (Dugdale et al. 2007) and thus reduce amounts of planktonic food available in the ecosystem. Unionized ammonia (NH_3) is toxic to fish at very low concentrations and recent research suggests that some Delta species (e.g., delta smelt) are particularly sensitive to this contaminant (Sommer 2008).

Target level: The target levels are set to minimize and/or eliminate these adverse effects.

Target 9. Reduce discharge of contaminants into Delta waterways and tributary rivers so that <5% of estuarine and anadromous fish populations exhibit evidence of toxic exposure and there are zero incidents of fish kills.

Metric: This performance target measures the prevalence of toxic contaminants in waters and sediments of the upper estuary, Delta, and tributary rivers by evaluating contaminant effects in fish species that are frequently and regularly sampled in the system. There are a number of histological and biomarker techniques that can be used to detect evidence of toxic exposure.

Rationale: Waters of the Delta and many of its tributary rivers are listed under the Clean Water Act's 303(d) list as impaired for a variety of contaminants,

including pesticides, dioxin, PCBs, metals, and mercury. These contaminants are transported into waters of the Delta and its tributary rivers via surface runoff, including agricultural and urban stormwater runoff, and direct discharges, including agricultural drains and waste water treatment plants. Recent research and monitoring has shown that Delta fishes periodically experience lethal exposure to contaminants (i.e., fish kills, reduced survival in bioassay tests) and exhibit sublethal responses (e.g., tissue and organ damage, DNA damage, reduced growth) (Sommer 2008).

Target level: The targets, no fish kills and less than 5% of fish populations exhibiting evidence of contaminant exposure, are designed to prevent incidents of direct mortality from contaminants and to reduce contaminant discharges to levels where only a small fraction of resident and migratory fish populations are exposed and/or affected.

4. Synergy Among Performance Targets

Most of the performance targets we have developed address multiple ingredients of the "restoration recipe" and will contribute towards achieving multiple desirable ecosystem functions and characteristics (Table A-4).

Table A-4. Applicability of performance targets to restoration recipe ingredients and desirable ecosystem characteristics.

Restoration Recipe Ingredients		**Performance Targets**
Restore Habitats	Tidal marsh	Target 2
	Upland/seasonal wetlands	Target 3
	Floodplain	Target 4
	Open water	Target 5 and 6
Restore Processes	Transport	Target 2, 4, 5 and 6
	Productivity	Target 2, 4, 5, 8 and 9
	Variability	Target 4, 5 and 6
Remove Stressors	Entrainment	Target 7
	Contaminants	Target 2, 3, 8 and 9
	Invasive species	Target 2, 3, 4, 5, 6, 8 and 9
Desirable Ecosystem Characteristics		**Performance Targets**
Viable, resilient populations	Estuarine fishes	Target 1
	Other species	Target 2, 3, 4 and 9
Migration corridor	Fishes	Target 2, 4, 5, 7, 8 and 9 Note: Some additional work to remove and/or mitigate physical barriers may also be required.
Human uses	Recreation	Target 1, 2, 3, 4, 5, 6, 7, 8 and 9
	Flood control	Target 2, 3 and 4
	Water quality	Target 2, 3, 8 and 9
	Buffers	Target 2, 3 and 4

5. Elements of a Strategic Plan for Ecosystem Restoration

Based on our analysis, the "restoration recipe" framework and the ecosystem performance targets described above, we have identified a suite of ecosystem management and restoration actions and strategies that can be implemented to achieve the performance targets and the Delta Vision goal for Delta ecosystem function (Table A-5). We have also identified how these actions will address or be affected by expected changes in the Delta (including sea level rise and changes

in timing and amounts of flow) and which performance targets and associated restoration strategies have relevance to the Delta Vision's other co-equal goal, a reliable water supply (Recommendations 1 and 7).

Table A-5. Restoration actions and strategies for meeting the ecosystem performance targets.

Target	Actions and Strategies
Estuarine fish abundance (Target 1)	1. Implement management and restoration strategies to achieve ecosystem performance Targets 2-9. Changing Delta conditions: Sea level rise and increases in water temperature may affect success and/or efficacy of some actions implemented to meet some ecosystem management and restoration performance targets. Reliable water supply: Achieving Target 1 will likely require reduced upstream and in-Delta water diversions and/or changes in diversion operations, patterns or timing.
Tidal marsh habitat (Target 2) and Upland and seasonal wetland habitat (Target 3)	1. Protect existing tidal marsh and upland/seasonal wetland habitats. 2. Restrict development on lands with inter-tidal elevations and adjacent uplands. 3. Acquire lands with inter-tidal elevations and adjacent uplands. 4. Restore tidal exchange to lands with inter-tidal elevations using appropriate project design to meet physical habitat restoration criteria and to maximize exclusion of invasive species. Changing Delta conditions: Sea level rise and existing urban development in an around the Delta may reduce the amount of available land with elevations suitable for restoration of these habitat types. Reliable water supply: No anticipated effects.
Floodplain habitat and inundation (Target 4)	1. Protect existing floodplain easements from development or other incompatible land use activities. 2. Restrict development on historic and potential floodplain lands with suitable elevations and proximity to rivers. 3. Modify weir structure and/or operations on the Yolo Bypass to allow inundation at lower flows and/or river stages to achieve frequency and duration target. 4. Acquire lands with suitable elevation and proximity to rivers for expansion of flood conveyance in the lower San Joaquin River and southern Delta. 5. Construct flood bypass and floodplain habitat in the lower San Joaquin Rivers and southern Delta using appropriate project design to meet physical habitat restoration criteria and to maximize exclusion of

	invasive species. 6. Increase reservoir releases in the Sacramento and/or San Joaquin Basins to inundate floodplains to meet frequency and duration target. Changing Delta conditions: Climate-related changes in precipitation and snowmelt patterns will likely increase the frequency and intensity of flood events in the Central Valley and the Delta. Restoration and/or more frequent inundation of floodplains may reduce flood risk to people and property. Reliable water supply: Depending on the strategy used, inundation of floodplain to meet the target could reduce water available for diversion and export.
Spring inflow (Target 5) and Fall inflow (Target 6)	1. Revise regulatory requirements to include increased seasonal freshwater inflow to the estuary. 2. Increase seasonal reservoir releases on Delta tributary rivers. 3. Decrease seasonal upstream and in-Delta water diversion rates. Changing Delta conditions: Climate-related changes in precipitation and snowmelt patterns will likely shift peak runoff to earlier in the year and may require modifications to reservoir and water diversion operations to meet new freshwater inflow targets. Intentional or unintentional changes in Delta geometry (e.g., levee breach) and sea level rise will affect the relationship between inflow and X2, requiring re-evaluation of the amounts of inflow necessary to provide sufficient quality and quantity of low salinity habitat for estuarine species. Reliable water supply: Increasing seasonal freshwater inflow to the estuary will reduce the amounts of water available for diversion and export.
Entrainment (Target 7)	1. Install fish screens. 2. Reduce water diversion amounts. 3. Change timing of water diversions. 4. Change location of water diversions. Changing Delta conditions: Sea level rise and/or levee failure on one or more Delta islands, which would cause salty water to intrude into the Delta, could a) reduce entrainment risk by reducing or eliminating current local water diversions and water export operations in the Delta, or b) increase entrainment risk by shifting distributions of estuarine fishes closer to Delta water diversions and export facilities. Reliable water supply: Reducing and/or shifting the timing of water diversions to meet the target could reduce the amounts of water available for diversion and export.
Ammonia (Target 8)	1. Reduce discharges of ammonia contaminated water. 2. Increase treatment to reduce ammonia concentrations in discharged water. Changing Delta conditions: Increases in population in Central Valley

	cities that discharge treated waste water in the Delta and tributary rivers will increase the volume of waste water discharges. Reliable water supply: No anticipated effects.
Contaminants (Target 9)	1. Implement or increase treatment of urban stormwater and agriculture runoff and discharges. 2. Increase tidal marsh, terrestrial grassland and seasonal wetland habitat area and distribution in Delta and Central Valley. 3. Require wetland and riparian buffers along river corridors. 4. Restrict discharges of untreated agricultural drainage into the Delta and tributary rivers. 5. Restrict household and/or agricultural use of problem pesticides and herbicides. Changing Delta conditions: Increases in population in Central Valley and Delta may increase household use toxic products. Reliable water supply: No anticipated effects.

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Increasing the Flexibility of Environmental Water Supply Operations in the Delta
Revised May 9, 2008

Overview

The Delta Vision and Bay-Delta Conservation Plan processes provide an opportunity to improve the flexibility with which water is managed to better protect fisheries in the Sacramento-San Joaquin Delta and Central Valley watershed. Fishery managers are constantly faced with new challenges due to changes in both hydrology and biology, as well as in their understanding of the effects of water project operations. The future is expected to bring even more change, potentially including significant changes in how water is conveyed to farms and cities. It is imperative that fishery managers, working together, have the flexibility to provide water to fish when they need it most.[1]

1. Environmental Water Operations in the Delta and Central Valley Watershed

The management of environmental water supplies in the Delta involves a series of protective operations that control Delta inflows, outflows, and in-channel flows, as well as limitations on diversions and exports. There are fundamentally two types of protective operating criteria, *prescriptive* and *flexible,* and both have appropriate roles in the overall control of the water system. Prescriptive operating are criteria generally those that are predetermined based on location, time, and hydrology. Flexible operating criteria are supplies managed in real- or near real-time according to the most recent science and monitoring. Improvements can and should be made to how flexible operating criteria are managed and their use should be expanded.

2. Operating Criteria in place today[2]

The prescriptive criteria in place in the Delta are primarily defined by the State Water Resources Control Board's 1995 Water Quality Control Plan. It includes objectives for both Delta inflow from the Sacramento and San Joaquin Rivers[3] and for Delta outflow (known as "X2" standards from February through June). The WQCP provides seasonally

[1] This proposal acknowledges that the conflict over how much water should be left in the natural environment and how much can be safely diverted for consumptive use in cities and on farms in California is expected to continue. Arguments over how much water the environmental needs will be made in other fora. The purpose of this proposal is to improve how the water that is dedicated to the environment is managed.

[2] The criteria imposed in 2007 by the federal court to protect Delta smelt are not discussed herein.

[3] There is no requirement that the WQCP's standards for Delta inflow from the San Joaquin River be met. Instead, under the "VAMP", water agencies have agreed to partially meet the WQCP objective and are paid for doing so.

adjusted limits on how much water can be exported from the Delta as a percent of total inflow to the Delta. This "E/I ratio" is mostly treated as a prescriptive standard, though fishery agencies do have the ability to "flex" the standard and have occasionally done so.

Flexible operating criteria presently in place principally include some "B2" supplies[4] and the Environmental Water Account (EWA). The EWA supplies can be divided into those made possible through the normal course of operations[5] and those that must be purchased with public funds.

While the effectiveness of these flexible operating criteria has been diminished by litigation, poor analysis and lack of funding[6], it is essential to distinguish between the beneficial aspects of having the flexibility to provide water to the environmental when it needs it the most and and mechanisms for assuring that that water is available when needed.

3. The role of flexible criteria in future operations

Flexible supplies through operations should play a larger role in the future for several reasons. The estuary itself, as well as our understanding of it, are both changing. Priorities change depending on biological needs and hydrologic conditions that are difficult to anticipate. Flexibility through purchase is less dependable as funding and purchase prices fluctuate from year to year, and long-term agreements are difficult to arrange. An efficiently managed estuary would include more emphasis on flexible supplies through operation and less on traditional regulatory standards and flexible supplies through purchase.

To be effective and broadly supported, environmental water supplies used through a flexible approach must be better assured than those in the past. Such assurances can and must be provided.

It is important to note that flexible operations are not intended to fully replace the role played by prescriptive operations. Sufficient flows are required at all times to provide suitable habitat for fisheries and it is expected that minimum flow criteria would still be in place for all streams and for Delta outflow.

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[4] B2 refers to the 800,000 acre-feet of dedicated yield authorized by Central Valley Project Improvement Act Section 3406(b)(2) for the primary purpose of doubling the natural production of anadromous fish in the Central Valley. Much of it is used for meeting the federal share of obligations for the WQCP and for some Endangered Species Act requirements. The remainder is available for discretionary actions either upstream or in the Delta.

[5] These EWA operational assets include 500 cubic feet per second of pumping capacity at the State Water Project's Banks Pumping Plant, the aforementioned E/I flexibility and 50% of the "State gain" portion of B2 water that the State finds available for export in the Delta.

[6] See Environmental Defense Fund's "Finding the Water" (2005) for an assessment of the flexible supplies authorized by the CALFED Plan that have not been made available for environmental uses.

4. Delta Governance should include a Delta Water Master

A Delta governance structure must facilitate cooperation between existing management agencies and their legal obligations to project fish and wildlife. This entity is called herein the "Delta Water Master" and is used below to identify those that would make the decisions of how to allocate flexible water supplies to the environment with whatever rules are in place. It is assumed that the Delta Water Master would have strong public oversight and would work closely with State and federal agencies.

5. Delta Water Master ownership and control of conveyance

The Delta Water Master would effectively own a percentage of the conveyance capacity at both existing facilities and any new facilities that are built as a result of the Delta Vision and BDCP processes.

Ownership criteria for water that passes through conveyance facilities should depend on whether that water is available for diversion due to "excess conditions" (i.e. in wet periods) or the water has been released from upstream reservoirs specifically for diversion in the Delta (in dry periods). Under excess or wet conditions, water should accrue to the Delta Water Master in proportion to its ownership of the conveyance facility. If stored releases are being made, supply accrues to the Delta Water Master only if its portion of the capacity is necessary to convey the water.

Under this approach DEW's supplies are self generating. There is no need for an annual budget for acquisition if the DEW can control infrastructure and have diversion (and storage) rights.

5. Delta Water Master ownership and control of stored water

It will be necessary for the Delta Water Master to store supplies south-of-Delta. The simplest place to store these supplies is in San Luis Reservoir – jointly owned by the State and Federal government and the largest off-stream storage project in the world. The Delta Water Master would be allowed to store supplies in San Luis Reservoir whenever space is available (i.e. with "junior" storage rights).

There will be times when storage space in San Luis is unavailable or insufficient to store the Delta Water Master's supplies. It may also be possible to store DEW supplies, through exchange, in other existing surface reservoirs that rarely fill and "spill", such as New Melones and Lake Mead. Also, it may be necessary to purchase or develop groundwater storage for use by the Delta Water Master. Groundwater storage is less flexible than surface storage as recharge and extrcation rates are limited, but when the two are operated in an integrated fashion, the groundwater storage can be as valuable as surface storage.

7. Delta Water Master actions to protect fisheries

When monitoring in accordance with the best available science indicates that diversions in the Delta should be limited to benefit fisheries, the Delta Water Master simply makes water already stored south-of-Delta available to the Central Valley Project or State Water Project. The Delta Water Master may also use its supplies in exchange for increased streamflows or Delta outflow.

Alternatively, the DEW should be allowed to go into debt if it does not have water physically in storage south-of-Delta but will be able to acquire supplies for repayment. This approach has been successful in the operation of the Environmental Water Account.

8. Funding the Delta Water Master

The role of the Delta Water Master is essentially to mitigate for the effects of water project operations. As such, its operating and capital expenses should financed by fees assessed through the sale of water to urban and agricultural districts. Under some circumstances, the Delta Water Master should be allowed to buy or sell water, but its role should primarily be to best manage its supply of environmental water[7]. Assurances must be in place that the sale of water is used for the benefit of the physical environment and not as a revenue source to support additional agency staff.

Fees to support the Delta Water Master should be provided by all agencies that extract water in the Central Valley watershed. If the costs are broadly and fairly distributed, the net cost to any particular agency need not be very high.

9. Modeling is necessary to refine project operating rules

The principles outlined above describe generally how water system operations could be improved in the Delta and Central Valley Watershed. Implementing these principles will require both detailed agreements and significant analysis of parameters to determine how much conveyance, storage and funding the protection of fisheries will require.

[7] Development of the Environmental Water Account assumed that public bond funds would be indefinitely available to support the purchase of water for the environment. This mistake must not be repeated.